

REMARKS

In response to the Official Action mailed on January 9, 2007, the application has been amended. No new matter has been added. Reconsideration of the rejections of the claims is respectfully requested in view of the above amendments and the following remarks.

On page 2 of the Official Action, claims 1 - 12 were rejected under 35 USC 103 as unpatentable over Sato et al (US2002/0051728, referred to below as Sato). This rejection is respectfully traversed.

Claim 1 has been amended to describe a lead-free solder alloy consisting of Sn, Ag, Cu, P, and at least one of Ni and Co in a total amount of at most 0.1 mass %. Amended claim 1 is supported by Table 1 of the application as filed, which discloses a number of examples of Sn-Ag-Cu-P-(Ni,Co) alloys. The numeric ranges for P, Ni, and Co given in claim 1 are supported by pages 8 and 9 of the specification as filed. Sato does not disclose or suggest such an alloy.

Sato discloses a solder ball and a method for its production. The solder ball contains Sn, a first additional element which is Ag and/or Cu, and at least one second additional element selected from the group consisting of Bi, Ge, Ni, P, Mn, Au, Pd, Pt, S, In, and Sb. There is no specific disclosure in Sato of a Sn-Ag-Cu-P-(Ni and/or Co) alloy as set forth in amended

claim 1. Sato also does not suggest such an alloy. Although the words "at least one second additional element selected from the group consisting of Bi, Ge, Ni, P, Mn, Au, Pd, Pt, S, In, and Sb" in Sato encompass an alloy including P and Ni, the combination of P and Ni is just one of over one thousand distinct combinations of the elements Bi, Ge, Ni, P, Mn, Au, Pd, Pt, S, In, and Sb. Sato shows no realization of employing P and Ni together with Sn, Cu, and Ag in such an alloy, and there is nothing in Sato that would lead a person skilled in the art to select this particular combination of elements out of the vast number of possibilities that Sato sets forth. The fact that a claimed substance may be encompassed by a disclosed generic formula does not by itself render that substance obvious. In re Baird, 29 USPQ2d 1550, 1552 (Fed. Cir. 1994). This is particularly the case when a generic formula encompasses a huge number of possibilities, as is the case with the words "at least one second additional element selected from the group consisting of Bi, Ge, Ni, P, Mn, Au, Pd, Pt, S, In, and Sb" in Sato. Thus, in order for the alloy recited in claim 1 to be obvious, there must be some specific suggestion in Sato to select this combination of alloying elements from the huge number of possible combinations covered by the generic formula. Since there is no such suggestion, Sato cannot render this claim obvious.

Although Sato does disclose several alloys containing P or Ni, the only specific alloys disclosed in Sato which contain these alloys are Sn-Cu based alloys (Examples 22, 24, 25, and 27 in Table 3), and there is not a single example in Sato of a Sn-

Ag-Cu based containing P or Ni. Even for these alloys, Sato deliberately conceals the exact composition by failing to reveal what "second additional elements" are contained in the alloys other than the "element in maximum content". As such, none of the examples of Sato clearly teaches an alloy containing P and Ni in combination.

The principal attribute of a solder ball having a composition as set forth in Sato is that it has a smooth surface on account of dendrites occupying at most 80% of the area of a cross section including the center of the ball. There is no mention in Sato of the attributes possessed by a lead-free solder according to the present invention, including resistance to impacts, resistance to yellowing at the time of bump formation, and improved resistance to heat cycles (as described on page 8, lines 21 - 24 of the present application). These attributes make the lead-free solder according to the present invention highly suitable for forming solder bumps of a BGA package, with which these problems become ever more severe as the size of solder bumps continues to decrease. As such, the present invention provides a significant advance to surface mount technology nowhere taught by Sato.

Accordingly, as Sato does not teach or suggest the composition set forth in amended claim 1, it cannot render claim 1 or claims 2 - 3 and 7 - 12 which depend from it obvious. These claims are therefore allowable. Claims 4 - 6 have been cancelled as unnecessary at the present time, so the rejection of these claims is now moot.

New claims 13 - 16 describe additional features of the present invention. These claims are allowable as depending directly or ultimately from claim 1. These claims further patentably distinguish the present invention from Sato by requiring the presence of Co. Sato does not disclose any alloys containing Co.

On page 4 of the Official Action, claims 1 - 12 were provisionally rejected on the ground of nonstatutory obviousness-type double patenting as unpatentable over claims 4 - 8 of copending Application No. 11/578,827. This rejection is respectfully traversed. After amendment, the claims of the present application no longer include any Zn, which is a required component of the claims of Application No. 11/578,827, and the Official Action has not cited any art to suggest modifying the claims of the copending application so as to result in a composition which does not contain Zn. As such, the claims of the present application cannot be obvious from the claims of the copending application.

In light of the foregoing remarks, it is believed that the

present application is in condition for allowance. Favorable consideration is respectfully requested.

Respectfully submitted,



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